MicroNode I/O™

Ethernet COMBO

User Manual

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Rev. 02
09/06

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Preface

About this manual

This manual is designed to serve as a guideline for the installation, setup, operation and basic maintenance of the MicroNode device. The information contained within this manual, including product specifications, is subject to change without notice. Please observe all safety precautions and use appropriate procedures when handling the MicroNode product and its related software.

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1 General Information

The MicroNode I/O™ product line provides high density, compact, and economical I/O solutions for popular Fieldbus Networks. The MicroNode COMBO provides 8 digital input/output points, 8 analog input points, and 4 analog outputs points to an Ethernet network. Additional data monitoring is available through a standard web browser and the TOOLweb™ tool side Interface (XML over HTTP). The MicroNode package provides flexible side or foot mounting and easy access to I/O through a standard 37-pin D-Sub connector. Below are the orderable part numbers for all Ethernet COMBO MicroNode configurations.

Table 1 Orderable Part Numbers

AS00246-01	MicroNode I/O, Ethernet MB, Combo, sink, front
AS00272-01	MicroNode I/O, Ethernet MB, Combo, sink, side
AS00273-01	MicroNode I/O, Ethernet MB, Combo, source, front
AS00274-01	MicroNode I/O, Ethernet MB, Combo, source, side

1.1 Conventions used in this User Manual

Warning	**The WARNING sign denotes a hazard to personnel. It calls attention to a procedure, practice, condition, or the like, which, if not correctly performed or adhered to, could result in injury to personnel.**
Caution	**The CAUTION sign higlights information that is important to the safe operation of the BlueBox, or to the integrity of your files. .**
Note	The NOTE sign denotes important information. It calls attention to a procedure, practice, condition, or the like, which is essential to highlight.

On screen buttons or menu items appear in bold and italics.
Example: Click ***OK*** to save the settings.

Keyboard keys appear in brackets.
Example: [ENTER] and [CTRL]

Pages with additional information about a specific topic are cross-referenced within the text.
Example: (See page xxx)

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2 Installation and Setup

This section describes the MicroNode Combo hardware setup and the Ethernet network interface. I/O connection examples are given in section 2.6 and 2.7.

2.1 Shipping Box Contents

- MicroNode Product

2.2 Hardware Description

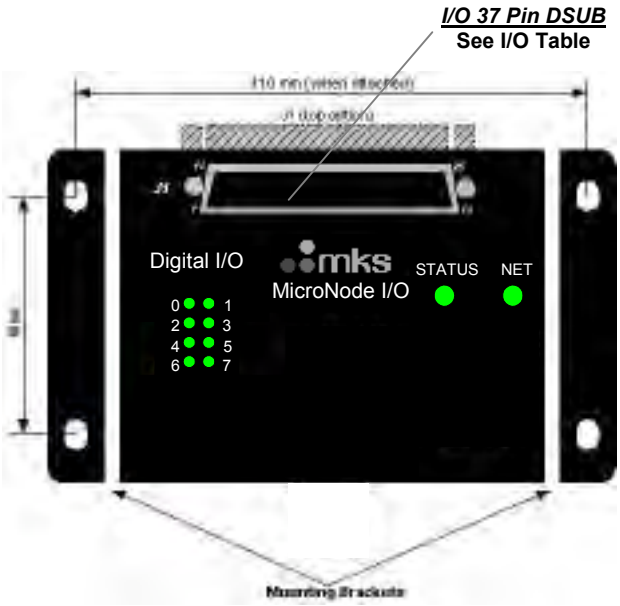

Figure 1 MicroNode COMBO Front Panel

2.3 Installation

Mount the unit on a horizontal or vertical surface, in a suitable location and/or enclosure for your application. Provide sufficient clearance and airflow to maintain a 0°C to 55°C ambient operating temperature range. Fasten the unit to the mounting surface using four screws (not provided) the 4mm wide mounting holes.

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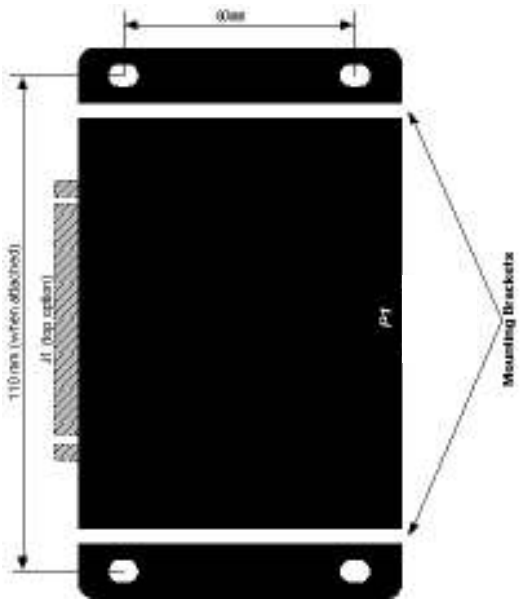

Figure 2 MicroNode Mounting Holes

Note	Height of 34mm, not including 37-pin D-Sub connector All dimensions are metric

2.4 Wiring

The MicroNode requires two connections – one to the Ethernet network and one to a 37-pin D-Sub connector. Ethernet and I/O cables are available from a variety of industrial sources. See table below for orderable I/O mating connectors.

Table 2 I/O Mating Connector

Description	MFG	Part Number
37-pin D-Sub Receptacle (solder cup)	Mouser	523-L77-DC37S
37-pin D-Sub Metal Hood	Mouser	523-17E-1727-2

Warning	**Follow all applicable electrical codes in your area when mounting and wiring any electrical device.**

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2.4.1 Power Supply Wiring

Connect an external 18-30 VDC power supply to the appropriate pins of the **I/O connector.** The connector should be wired according to the connector pin out in Section 2.4.2.

2.4.2 I/O Wiring

The MicroNode provides access to the I/O via a male 37-pin D-Sub connector. The pin out is shown in the following figure.

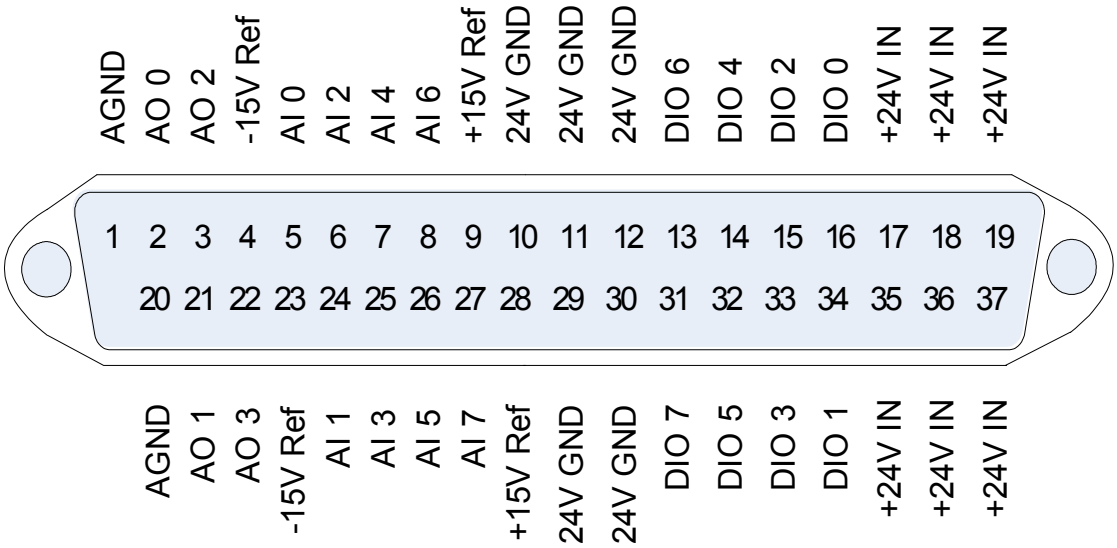

Figure 3 MicroNode COMBO Connector Pin out

2.5 I/O Monitoring

There are multiple control and data monitoring interfaces for the unit:

- Modbus/TCP Ethernet control
- Web browser, manual control
- Web browser, configuration and graphical data monitoring
- XML streaming data acquisition, using TOOLweb™ protocol

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2.6 Digital Input Interface Example

Units are purchased with either sinking (active low) or sourcing (active high) I/O. Each input circuit includes an indicator LED in series with the detection opto-coupler. The opto-coupler isolates the processor from the inputs. The inputs require 1.5 mA in order to turn on.

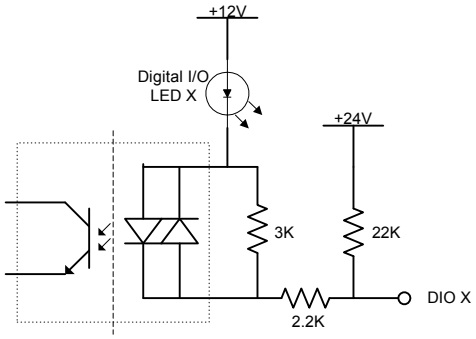

Figure 4 Digital Sinking Input (active low)

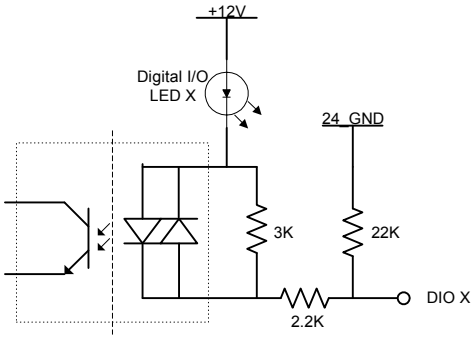

Figure 5 Digital Sourcing Input (active high)

Below is an example of how to use the digital input interface for both the sinking and sourcing hardware configurations. The digital I/O circuitry is powered from an external +24-volt power source via the I/O connector.

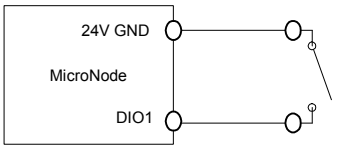

Figure 6 Sinking Input

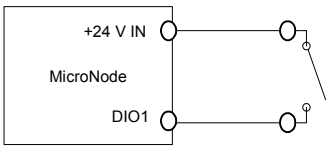

Figure 7 Sourcing Input

2.7 Digital Output Interface Example

The individual outputs will support up to 200 mA load per channel. Each output is thermally protected against short- circuiting (500 mA typically) and includes under voltage protection. The output Fault State is accessible through software. External Schottky diodes are provided for output transient protection and each I/O point is protected with a self-resetting poly fuse rated for 500 mA. Outputs default to the OFF condition during power up and processor reset conditions. The figure below shows the output circuitry.

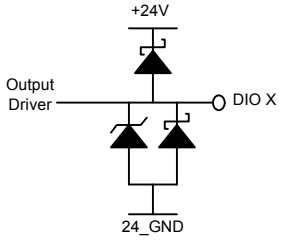

Figure 8 Output Circuit

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Below is an example of how to interface with the digital outputs for both the sinking and sourcing hardware configurations. The digital I/O circuitry is powered from an external +24-volt power source via the I/O connector.

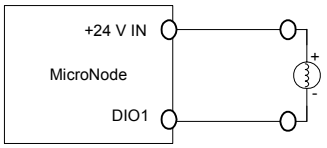

Figure 9 Sinking Output

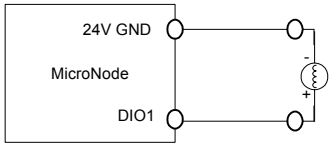

Figure 10 Sourcing Output

2.7.1 Analog Inputs

The analog inputs are coupled directly to the processor and are implemented using 12 bit A/D converters. This device supports software settable ranges of 0V to +10V, and –5V to +5V.

All analog circuitry is powered from an internal ±15 Vdc power source (1 Watt) derived from the 24 V I/O power. The +15 V and -15 V power is protected with a self-resetting poly fuse rated at 100 mA.

2.7.2 Analog Outputs

The analog outputs are implemented using 12 bit D/A's with a –10V to +10V output range. The output drivers are capable of driving 2 KΩ (5 mA) output loads. Analog outputs default to 0 volts during power up and processor reset conditions. The analog output power is derived from the same 15 V± power used for the analog inputs.

2.8 Diagnostic Serial Port

The Ethernet MicroNode has an RS-232 serial diagnostics interface. The serial port provides access to a proprietary command-line interface with specific commands to display advanced or detailed status information, and to control configuration parameters including those available via the Web interface. Some are intended for advanced or factory use, and are not normally exposed via the Web interface.

The command-line interface supports the "help" command, which displays a brief summary of all commands. The commands are self-explanatory to anyone sufficiently familiar with the controller theory of operation, and the technologies involved.

The diagnostics serial port is also be used to display all legally required Copyright messages, current version information, and hardware configuration information during the unit's power-up sequence.

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Table 3 Diagnostic Serial Port Connector Pin out (Female DB-9)

Pin	RS232 Function
2	TXD
3	RXD
5	SGND

2.9 Ethernet Connector

The standard 100/10 BaseT Ethernet Port uses a standard shielded RJ45 connector. Indicators for the Ethernet Port are located on the front panel.

2.10 Status LED's

There is one LED for the unit status and one for the network status located on the front panel. Indicators for the Ethernet port are also located on the front panel. The table below shows the meaning of different LED states.

Table 4 Modbus LED Status Conditions

LED Color	Status LED	Network LED
Off	No power	No Power
Solid Red	Not Supported	No Network Response (Disconnected)
Solid Amber	Booting	Network Initializing, configuring DHCP
Alternating Red-Green	Watchdog failure, outputs off	Network Configuration Error
Alternating Red-Amber	I/O failure	Null network, IP address configuration Error
Alternating Green-Amber	Not Supported	Not Supported
Blinking Amber	Unit Okay, Diagnostic Mode, Watchdog Inactive	Standing by for Modbus master to connect
Blinking Green	Unit Okay, Production Mode, Watchdog Active	Modbus master present and active

2.11 Rotary Switches

The Ethernet MicroNode has three rotary switches on its front panel, each switch represents a decimal digit 0 through 9. The switches serve two purposes:

1. Determine the least significant byte of the IP address
2. Determine the operating mode

Table 5 Switch Conditions

Mode	Switch Settings	Watchdog	IP address
Production	000	Enabled	DHCP
Production	001-254	Enabled	192.168.0. (Switch Settings)
Diagnostic	300	Disabled	DHCP
Diagnostic	301-554	Disabled	192.168.0. (Switch Settings – 300)

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When the unit is in **normal (production)** mode, the combinations of the rotary switches represent a decimal number between 000 to 254. When the number is between 001 to 254, this number is used to configure the last network segment of the **static** IP address, with a factory set prefix 192.168.9.xxx, or any other prefix that may be configured through the diagnostic serial port. If the rotary switch combination is set to 000, the unit will obtain an IP address automatically using DHCP protocol.

To set the operating mode to **diagnostics mode** set the rotary switches to 300 or above. In Diagnostic mode the watchdog is disabled, and the user is allowed to change the value of the outputs via the Web-based diagnostic pages. Setting the switches to a value of 300 configures the IP address using DHCP, and setting the switches above 300 configures the unit to a static IP address.

For example: A switch setting of 330 means that the diagnostic mode is set, and the IP address is statically configured to 192.168.9.30.

Note Rotary switches settings above 554 are reserved and should not be used.

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3 Quick-Start

- Set the IP address switches on the front of the unit to **3 1 0**. The unit is now in Diagnostic mode with a static IP address. The units IP address will be 192.168.0.10. Power the unit by supplying +24 volts to the I/O connector. See section 2.4.2 for wiring information.

- Attach a network crossover cable between the MicroNode and your PC or use a HUB to build a small network.

- Modify your PC network TCP/IP settings using the computer's *Connection Properties* menu to match the following:

  PC IP Address: 192.168.0.1
  PC Netmask: 255.255.255.0

- Open a web browser window and enter **http://192.168.0.10** in the address line. There is a slight delay as the unit transfers content to your local browser. The main Device page is displayed. If you are unable to load the page, check the units switch settings and ensure the IP address of the PC is 192.168.0.1. Also check the Ethernet cable connections to your PC and to the MicroNode.

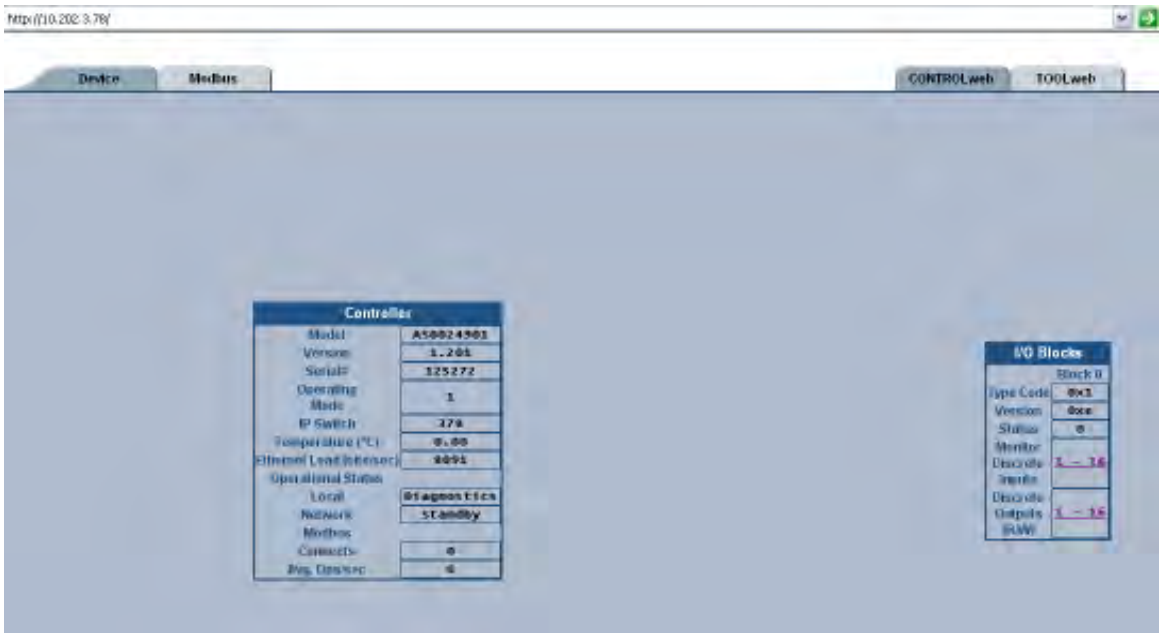

Figure 11 Device Web page

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- The Device page provides current status for the unit and provides basic control of the outputs through the I/O block links, control of the outputs is only allowed when the device is in **diagnostic mode**. Once in production mode, the outputs can no longer be controlled via the webpage.

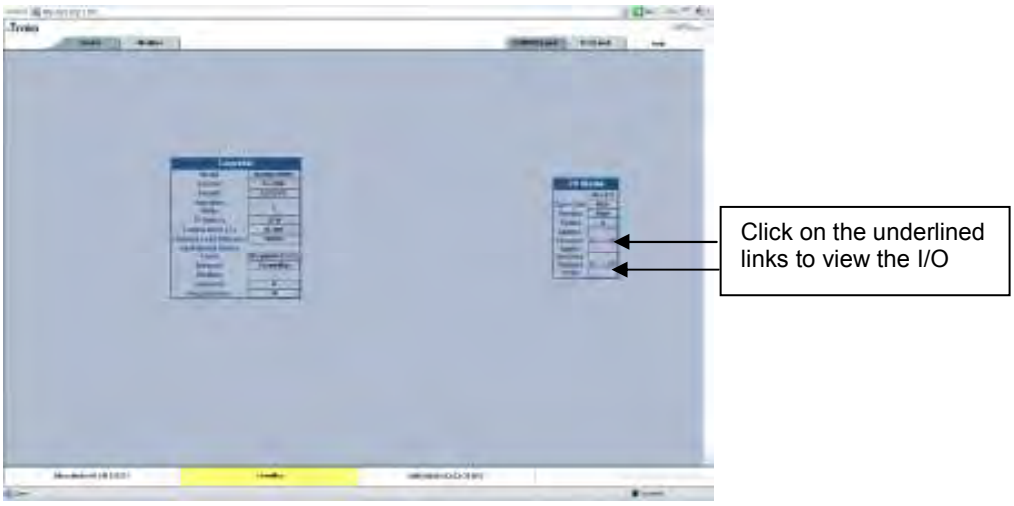

Figure 12 I/O Links on Homepage

- Selecting the underlined items in the I/O blocks chart will launch secondary I/O pages. The following figures show the digital and analog input statuses that are displayed after an underlined link is selected.

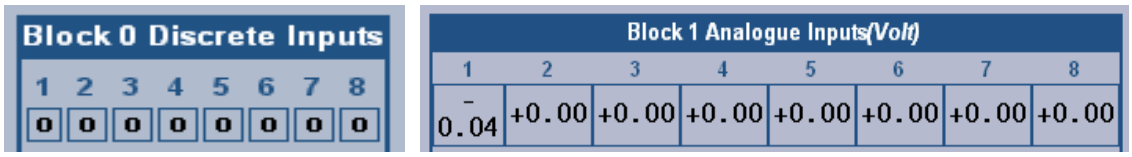

Figure 13 Digital and Analog Input Web Page

- The digital and analog output webpages provide basic control of the output points if the unit is in **diagnostics mode**. The pull down menu allows the user to select the digital output state or to enter in a value for an analog output. There is also a Blinking Output pull down menu that allows the user to put an output into a blinking or oscillating state.

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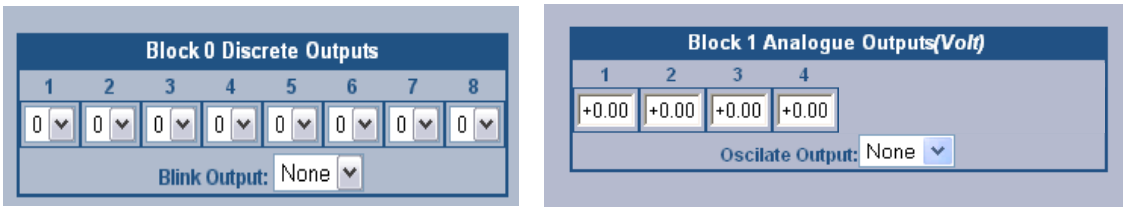
Block 0 Discrete Outputs
1 2 3 4 5 6 7 8
0 0 0 0 0 0 0 0
Blink Output: None
Block 1 Analogue Outputs(Volt)
1 2 3 4
+0.00 +0.00 +0.00 +0.00
Oscilate Output: None

Figure 14 Digital and Analog Output Webpages

- Click on the link for the analog or digital output page. Change the state of one of the outputs by selecting an option from the pull down menu and for the case of analog enter a number within the range of –10V to +10V.

If the output does not come on, check the status and network LEDs on the front of the unit. The module LED should be blinking amber and the network LED should be blinking green. If the states are different, reference the LED status table in section 2.10. Also, check the + 24V power connection.

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4 Network Configuration

The MicroNode network settings configure the 100/10 BaseT Ethernet port. The following are factory-default Ethernet settings.

Parameter	Setting
IP-Address	192.168.0.X
Subnet mask	255.255.255.0
Default Gateway	None

Note Reading or changing the network settings of an unknown unit is achieved by connecting via a serial terminal session. See section 4.2.

4.1 Connecting to a computer via TCP/IP

The Ethernet MicroNode is configured and controlled via its Ethernet port. The following steps show how to configure a Windows PC for first-time communication with a unit.

1) Connect the MicroNode to your PC by using an Ethernet crossover cable for direct point-to-point connection, or connect through an Ethernet switch or hub.

Note Some 10/100MB Ethernet interfaces may not detect the MicroNode when using an Ethernet crossover cable. If you experience problems, connect through an Ethernet switch or hub.

2) Change your PC network TCP/IP settings so that PC resides on same sub network as the MicroNode.

   Use the following TCP/IP settings if you have **not changed** the MicroNode IP address from its factory default.

   IP Address: 192.168.0.1
   Subnet Mask: 255.255.255.0
   Default Gateway: none

3) Open your PC web browser (Netscape, Internet Explorer, or equivalent). Enter the IP address in the web browser's address line.

   http://192.168.0.X

   The main page for the MicroNode will open.

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4.2 Connecting via a Serial Terminal Session

Connect your computer to the diagnostics port (DB9) using a standard null-modem cable.

Using a terminal program such as Microsoft® HyperTerminal or Tera Term Pro you can now communicate via the diagnostics port of the unit. The serial connection parameters are listed in the following table.

Table 6 Serial Connection Parameters

Parameter	Value
Baudrate	38400
Data bits	8
Parity	None
Stop bits	1
Flow Control	None

Once connected, the IP address can be changed by typing the **menu** command and pressing **m** within 3 seconds: The current IP address of the unit can be view by just typing **menu**.

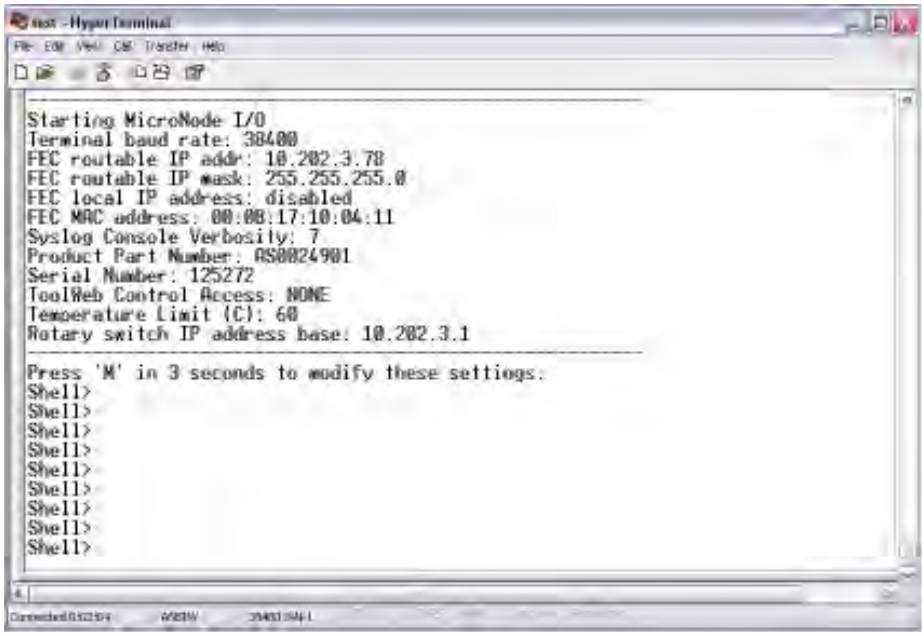

Figure 15 Serial Diagnostics Menu Command

The serial interface provides diagnostics for the device. The **help** command can be used to display all commands available through the serial interface.

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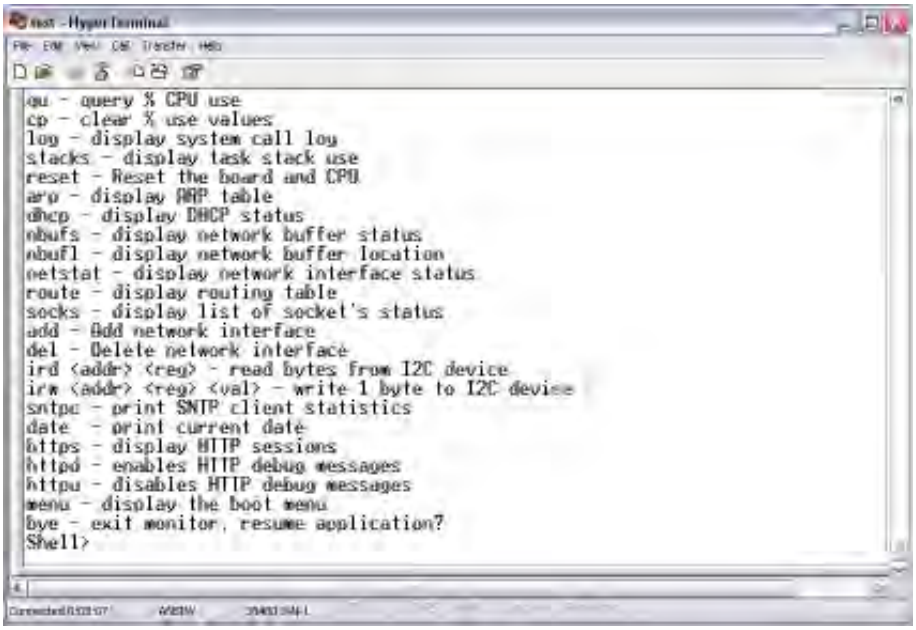
qu - query % CPU use
cp - clear % use values
log - display system call log
stacks - display task stack use
reset - Reset the board and CPU
arp - display ARP table
dhcp - display DHCP status
mbufs - display network buffer status
mbufl - display network buffer location
netstat - display network interface status
route - display routing table
socks - display list of socket's status
add - Add network interface
del - Delete network interface
ird <addr> <reg> - read bytes from I2C device
iwr <addr> <reg> <val> - write 1 byte to I2C device
sntpc - print SNTP client statistics
date - print current date
https - display HTTP sessions
httpd - enables HTTP debug messages
httpu - disables HTTP debug messages
menu - display the boot menu
bye - exit monitor, resume application?
Shell>

Figure 16 Serial Diagnostics Help Command

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5 CONTROLweb™ User Interface

The user interface is web based. You can access it by simply browsing to the IP address of the CONTROLweb™ node.

Note Microsoft Internet Explorer versions older than 5.5 may not function as expected due to limitations of the browser.

The main page of the CONTROLweb™ unit shows a top view of the module. This is referenced as the Device tab.

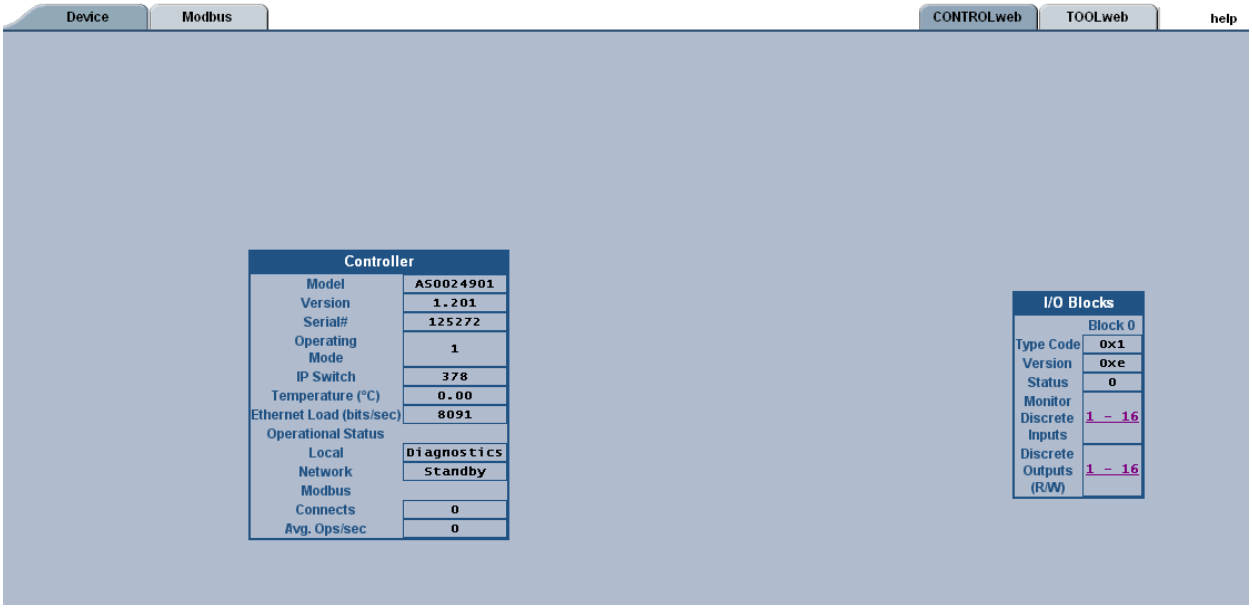

Figure 17 Device Homepage

Dynamic diagnostic details available from this page are:

- Unit data- model number, serial number, and software version
- Operational Mode
- Operation statistics
- Ethernet load
- Modbus details

By selecting I/O of interest from the main page, a pop-up will appear for each section of I/O.

- Inputs can be read. (Dynamic)
- Outputs can be set manually if the unit is in **diagnostics mode**

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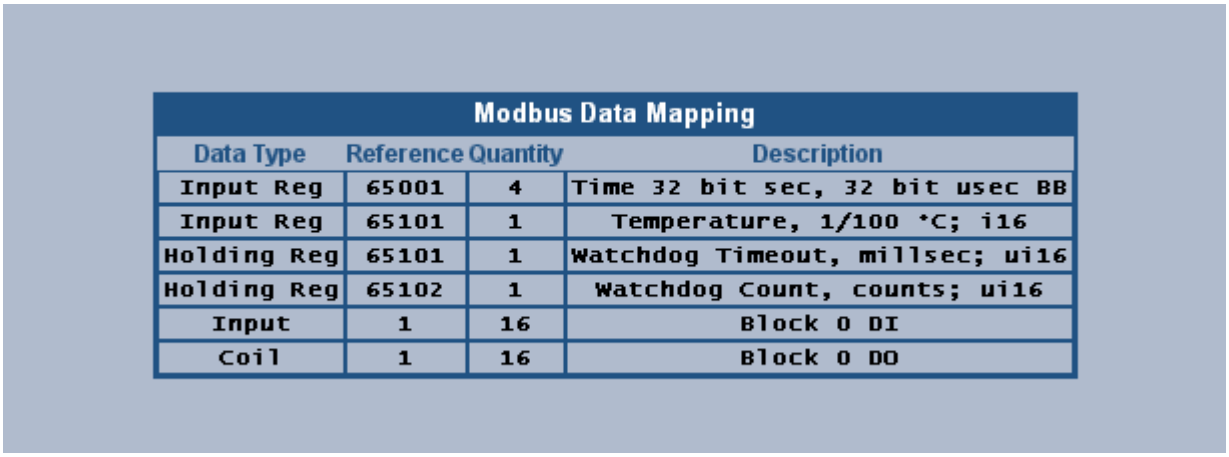
6 Modbus/TCP Interface

All MicroNode's Modbus DeviceID is fixed at 255 decimal.

Use the Modbus mapping details provided through the web browser interface under the ***Configuration*** tab.



Modbus Data Mapping

Data Type	Reference	Quantity	Description
Input Reg	65001	4	Time 32 bit sec, 32 bit usec BB
Input Reg	65101	1	Temperature, 1/100 °C; i16
Holding Reg	65101	1	Watchdog Timeout, millsec; ui16
Holding Reg	65102	1	Watchdog Count, counts; ui16
Input	1	16	Block 0 DI
Coil	1	16	Block 0 DO

Figure 18 Modbus Data Mapping

The address map for the Modbus registers is listed in the table below.

Table 7 Modbus Register Map

Register Type	Address	Data Type	Range	Description
Input	0-15	Bool	0-1	Provides status of Block 0 and Block 1 Digital inputs
Coil	0-15	Bool	0-1	Controls Block 0 and Block 1 Digital Outputs
Input Reg	65000	Real		Real Time Clock value
Input Reg	65100	Int 16 bit	1-100	Internal Device Temperature in Degrees Celsius
Holding Reg	65100	Unsigned Int 16 Bit	0, 100-65535	Watchdog timeout value in Milliseconds. Writing a value of 0 to the register disables the Watchdog
Holding Reg	65101	Unsigned Int 16 Bit	0-65535	Watchdog Timeout counter, Writing to the register resets the counter

Table 8 Modbus Commands

Command	Description
ReadDiscreteInputs (0x02)	As defined in the MODBUS Application Protocol Specification, the device shall support reading one or more discrete inputs via the ReadDiscreteInputs function.

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ReadCoils (0x01)	For the purposes of this device, a coil shall be synonymous with a Discrete Output. As defined in the MODBUS Application Protocol Specification, the device shall support reading one or more coils (discrete outputs) via the ReadCoils function.
WriteSingleCoil (0x05)	
WriteMultipleCoils (0x0F)	
ReadHoldingRegisters (0x03)	As defined in the MODBUS Application Protocol Specification, the device shall support reading one or more registers via the ReadHoldingRegisters function.
WriteSingleRegister (0x06)	Is defined to access the HoldingRegisters. When accessing an IO point, the following method is used.

Note the digital input address is the reference number of the digital input minus one. (**DI address = Reference of DI Number – 1)**

For example for DI number = 4 with a reference of 4, the DI address would be 3.
Map this data in your Modbus/TCP scanner.

Note **For more details on Modbus, see** http://www.modbus.org**.**

WATCHDOG TIMER

The Modbus/TCP Interface includes a watchdog timer to monitor and react in the event that communications are not maintained between the client and the server within a programmed amount of time. If time between communications exceeds the timeout value (programmed into the Watchdog Timeout Value Holding Register) a timeout will occur and the Watchdog Timeout Counter register will increment 1 count for every timeout event that occurs. In the event that a timeout occurs the Status LED will alternate between red-amber and green. Once a timeout occurs all outputs are disabled.

The Watchdog Timeout value can be set from 100 ms to 65535 ms and can be disabled by writing a value of 0 to the register. The Watchdog Timeout Counter increments on each timeout event and is cleared by writing any value to the register.

Note To ensure that the Watchdog Counter register is cleared the register should be written to during initialization.

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7 TOOLweb™ Interface

TOOLweb™ is a system-wide program for enabling and gathering real-time data from multiple elements of a process, and providing this data to factory based modules for analysis, FDC and APC.

The Ethernet MicroNode uses TOOLweb™ functionality for the following:

- Web based tools for data analysis and debug, directly from the I/O module
- Real time data acquisition, using XML over HTTP

7.1 TOOLweb™ User Interface

TOOLweb™ functions are accessed and configured through the web browser interface. Users must determine the Key Process Variables. Once these variables are named and scaled, they are available for data collection and analysis.

7.1.1 Control Access

Create the allowed permissions to process data.

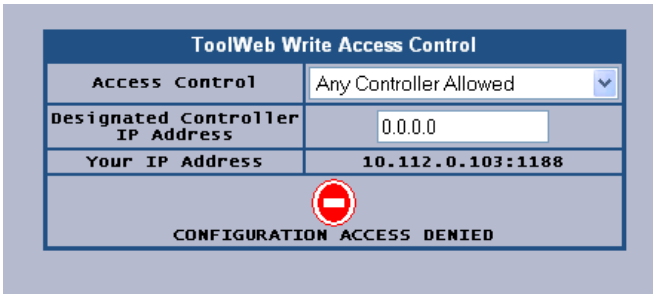

Figure 19 Access Control

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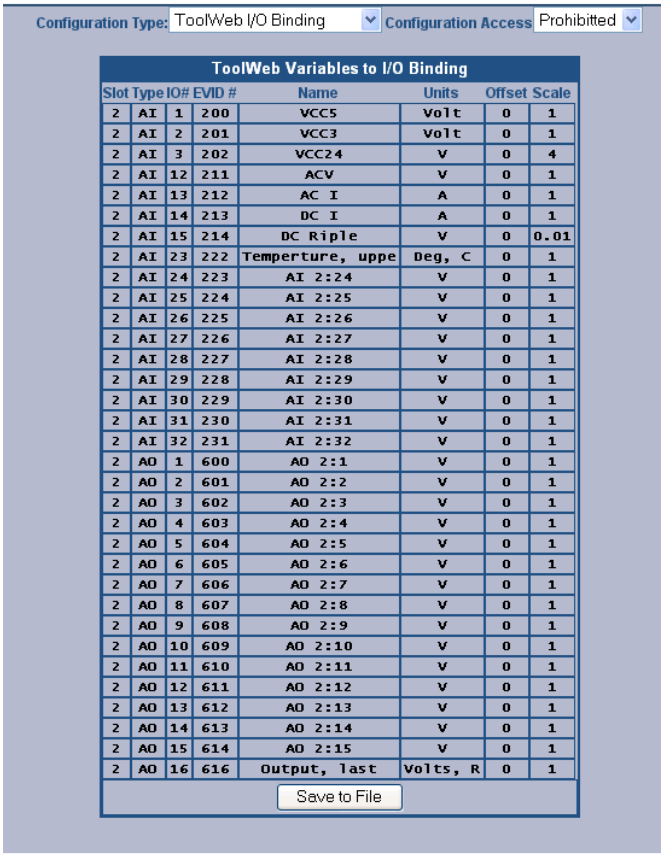
7.1.2 I/O Bindings

Select the I/O points to be available for TOOLweb™ functions. Each point is selected, given a description, and scaled to meaningful process units. Up to 64 variables can be configured.


Configuration Type: ToolWeb I/O Binding
Configuration Access Prohibitted
ToolWeb Variables to I/O Binding
Save to File

Slot	Type	IO#	EVID #	Name	Units	Offset	Scale
2	AI	1	200	VCC5	Volt	0	1
2	AI	2	201	VCC3	Volt	0	1
2	AI	3	202	VCC24	V	0	4
2	AI	12	211	ACV	V	0	1
2	AI	13	212	AC I	A	0	1
2	AI	14	213	DC I	A	0	1
2	AI	15	214	DC Riple	V	0	0.01
2	AI	23	222	Temperture, uppe	Deg, C	0	1
2	AI	24	223	AI 2:24	V	0	1
2	AI	25	224	AI 2:25	V	0	1
2	AI	26	225	AI 2:26	V	0	1
2	AI	27	226	AI 2:27	V	0	1
2	AI	28	227	AI 2:28	V	0	1
2	AI	29	228	AI 2:29	V	0	1
2	AI	30	229	AI 2:30	V	0	1
2	AI	31	230	AI 2:31	V	0	1
2	AI	32	231	AI 2:32	V	0	1
2	AO	1	600	AO 2:1	V	0	1
2	AO	2	601	AO 2:2	V	0	1
2	AO	3	602	AO 2:3	V	0	1
2	AO	4	603	AO 2:4	V	0	1
2	AO	5	604	AO 2:5	V	0	1
2	AO	6	605	AO 2:6	V	0	1
2	AO	7	606	AO 2:7	V	0	1
2	AO	8	607	AO 2:8	V	0	1
2	AO	9	608	AO 2:9	V	0	1
2	AO	10	609	AO 2:10	V	0	1
2	AO	11	610	AO 2:11	V	0	1
2	AO	12	611	AO 2:12	V	0	1
2	AO	13	612	AO 2:13	V	0	1
2	AO	14	613	AO 2:14	V	0	1
2	AO	15	614	AO 2:15	V	0	1
2	AO	16	616	Output, last	Volts, R	0	1

Figure 20 Collection Variables

7.1.3 Data Collection Plans

A data collection plan selects the process variables of interest, and the frequency of data collection. Each collection plan can then be viewed using a Charting Applet, or can be downloaded in CSV format to your local PC.

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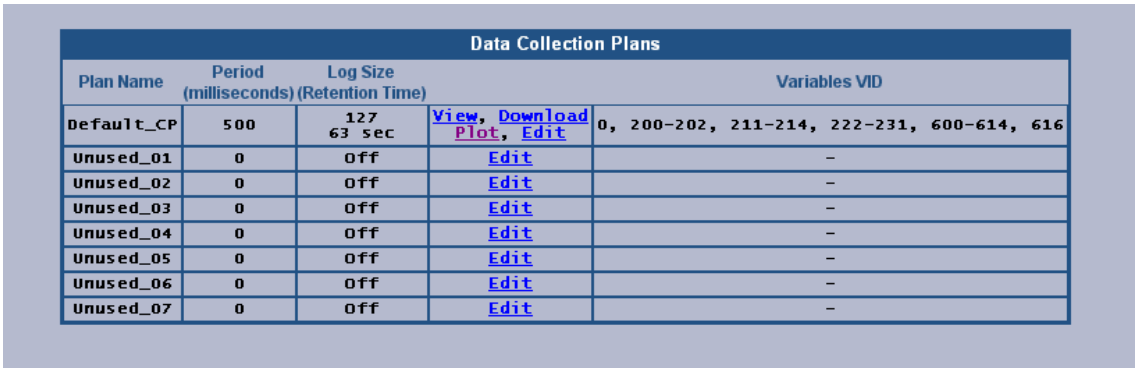

Data Collection Plans

Plan Name	Period (milliseconds)	Log Size (Retention Time)		Variables VID
Default_CP	500	127 63 sec	View, Download Plot, Edit	0, 200-202, 211-214, 222-231, 600-614, 616
Unused_01	0	Off	Edit	-
Unused_02	0	Off	Edit	-
Unused_03	0	Off	Edit	-
Unused_04	0	Off	Edit	-
Unused_05	0	Off	Edit	-
Unused_06	0	Off	Edit	-
Unused_07	0	Off	Edit	-

Figure 21 Collection Plan

7.1.4 Data Collection Plan Editing

Create a collection plan, and select the key process variables of interest:

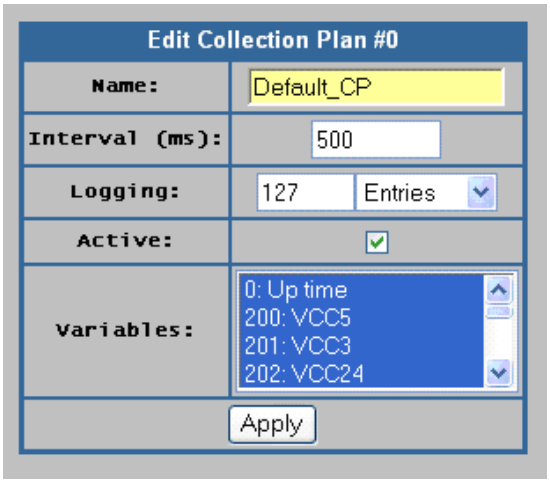

Figure 22 Edit Collection Plan

7.1.5 Charting Applet

Once a data collection plan is configured, you can view the data using a built-in charting applet.

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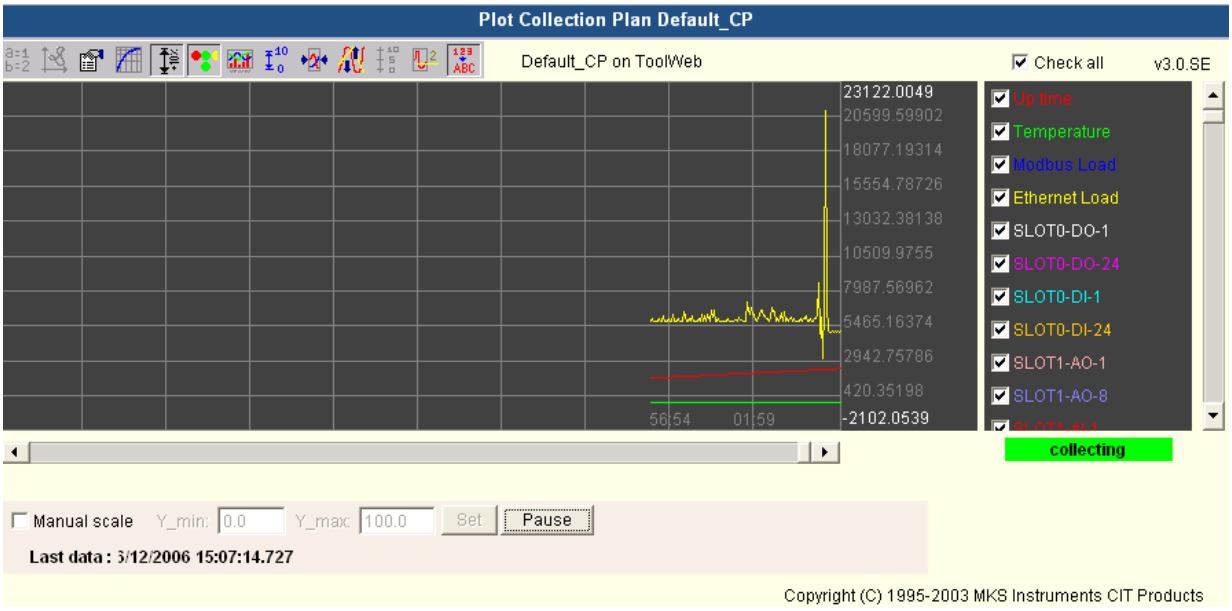

Figure 23 Charting Applet

7.1.6 Download Data to Local PC

Collection plan data can also be downloaded in CSV format:

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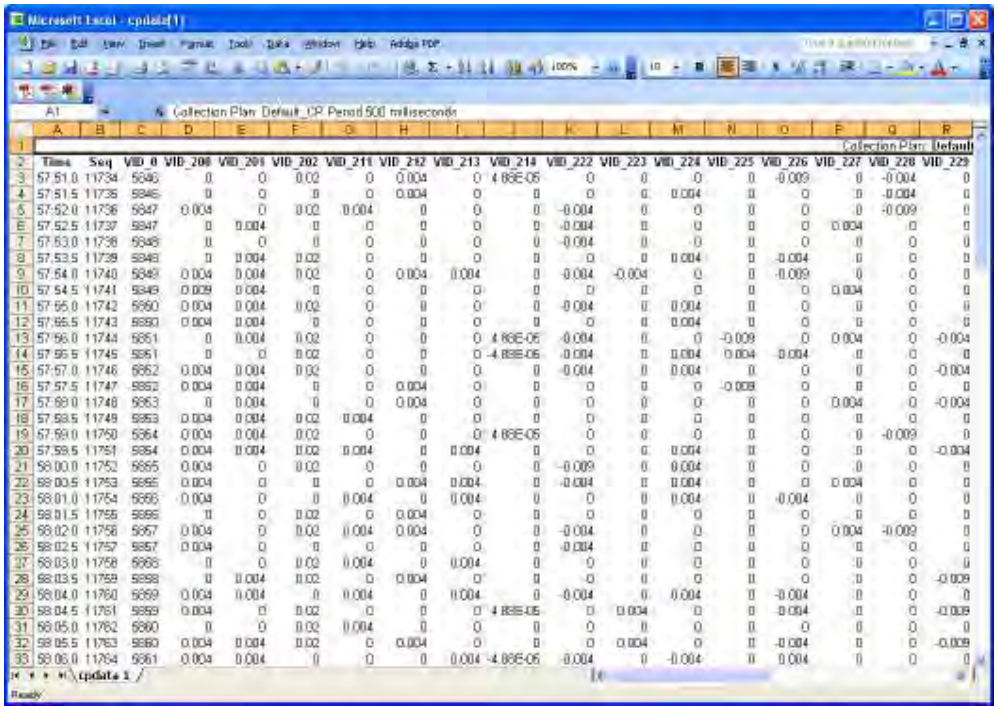

Figure 24 Collection Plan Data

7.2 TOOLweb™ Tool Side Interface

The tool side interface is relevant when a MicroNode is connected to a BlueBox™ in a semiconductor process tool APC, and e-diagnostic system.

The following messages are supported via the TOOLweb™ tool side Interface:

Table 9 TOOLweb Messages

Message	Supported
CapabilitiesRequest/Response	Yes
Polling	Yes
Tracing	Yes
Bulktrace	No
Events	No
ControlParameter	Yes
SetRequest/Response	No

The names and units as exposed in the CapabilitesResponse are the same as defined in the channel configuration. Reference the BlueBox™ Manual for additional details on interfacing with BlueBox™.

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Note

Microsoft Internet Explorer 5.0.1 or higher is required. Microsoft Internet Explorer versions less than 5.5 may not function as expected due to limitations of the browser.

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8 Appendix A - Specifications

Physical Specifications

Criteria	Specifications
Dimensions	80mm (3.1496") Height X 120mm (4.7244") Width X 34mm (1.339") Depth
I/O Connector	37-pin male D-sub
Ethernet Connector	100 BaseT, RJ45 with EMI filter,LED indicators
RS-232 Connector	38,400 bps, TXD, RXD; DB9 connector
Weight	200 g (0.44 lb)

Environmental Specifications

Criteria	Specifications
Operating Temperature	0 to +55°C
Storage	-40 to +85 °C
Humidity	5 to 95% non-condensing

Functional Specifications

Criteria	Specifications
BUS Interface	Ethernet –Modbus/TCP
Front Panel Indicators	8 Digital I/O points, Network Status, Module Status
Rotary Switches	IP address, operating mode

Power Specifications

Criteria	Specifications
Input	Powered from I/O connector +24VDC@120 mA min
Isolation	DC/DC Isolation

Input/Output Specifications

Criteria	Specifications
Number of Digital I/O	8 points (input or output)
Digital Input Current sinking Current sourcing	 Active Low- 1.5 mA min, Active High-1.5 mA min,
Digital Output Current sinking Current sourcing Current max	 Active low, 200 mA max / channel Active high, 200 mA max / channel 800 mA for DIO 0-7,
Analog Input	8 single-ended points 12 bit Software selectable range (0-10V), (–5 to +5V)
Analog Output	4 single -ended points 12 bit Range (–10 to +10V) 5mA / channel into a 2 KΩ load

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